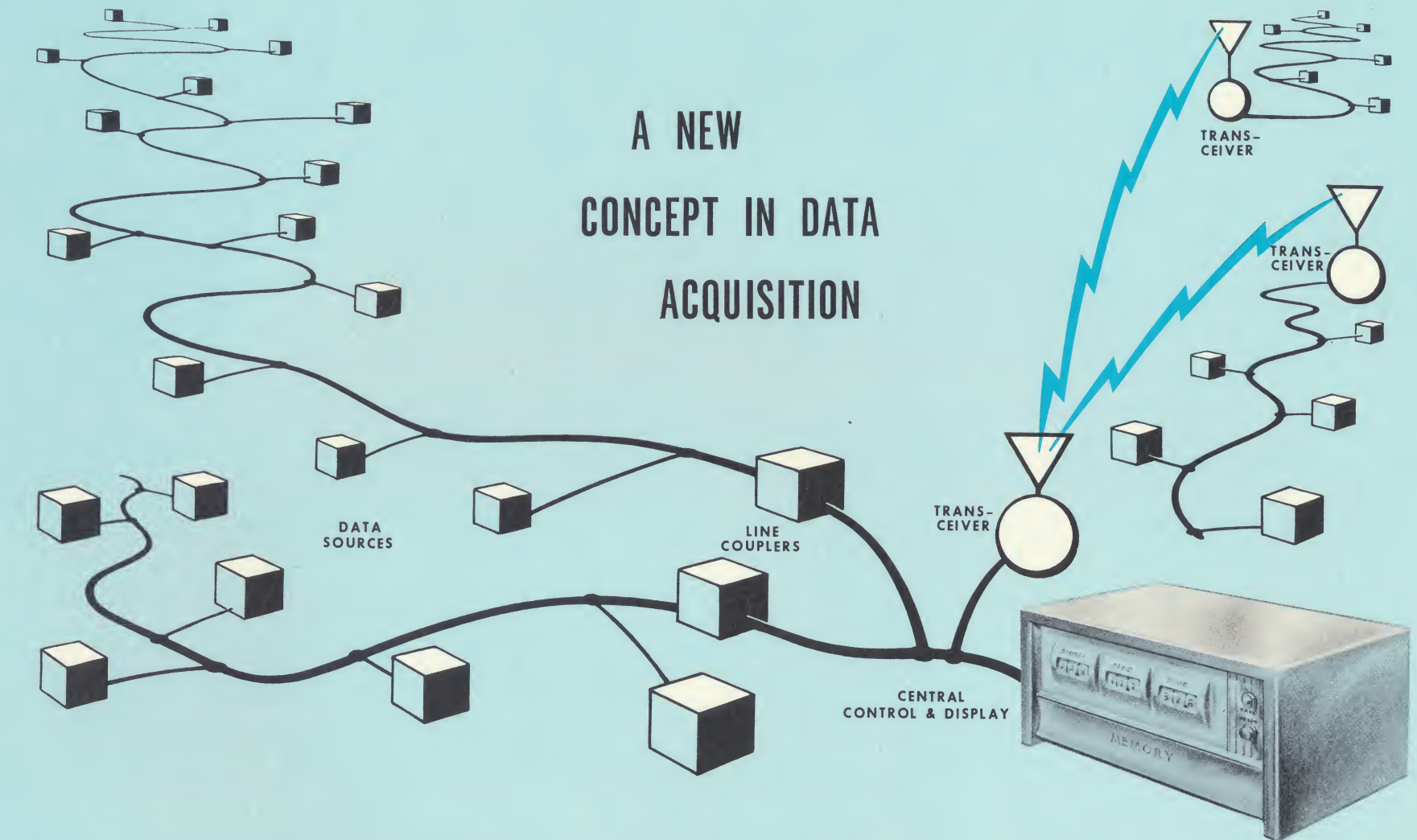


A NEW
CONCEPT IN DATA
ACQUISITION



ELECTRONIC SPECIALTY CO.

A NEW CONCEPT IN DATA ACQUISITION

The new ES data acquisition system concept, the DAS, is intended for situations where multiple electrical output transducers, widely distributed, must be continuously monitored from a central point for operational, safety, and historical reasons. DAS also makes these functions readily and economically available: continuous comparison against preset standards; display and alarm by exception, (hence, the avoidance of excessive amounts of data); easy digital conversion.

Each data source, composed of a DATU (Data Acquisition Time-duration Unit) directly connected to an electrical output transducer, is successively and discretely interrogated by a pair of variable duration pulses. The response is a pulse duration that is linearly proportional to the measurand. Thus, a single communications channel can be economically shared by as many as 140 data sources. Speeds of 1000 sources per second can be attained and accuracies of the order of $\pm 0.5\%$ to $\pm 1.0\%$ can be expected.

BASIC ADVANTAGES OVER CONVENTIONAL METHODS

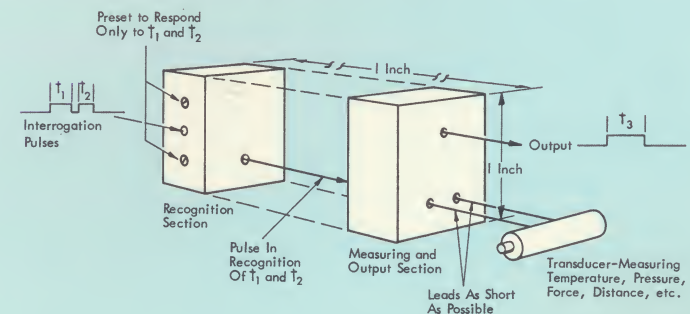
1. Reliable — simple, dependable, solid-state equipment operated in a conservative, full-safe mode. Techniques greatly reduce effects of noise and common-mode signals and hence, the occurrence of fallacious indications and alarms. Low cost, small size — weight, and simplicity of control equipment allows complete redundancy.
2. Practical — The telemetering of hundreds of quantities, originating at dozens of centers, spread over many miles is only technically and economically practical by these methods.
3. Less Expensive — Often one-half to one-third the initial cost of alternate methods. Can be installed, programmed and maintained by instrument personnel rather than computer technicians.
4. Continuous monitoring without generating masses of redundant data — The techniques allow each response to be compared to preset levels (at preset tolerances). If values are those anticipated, no action is taken, data is not accumulated, and the operator is not distracted. Values beyond limits become the "exception" and receive full attention, automatic action and/or recording.

5. Small and Lightweight — The DATU's are on the order of one cubic inch and only weigh a few ounces. The central control equipment can be about one cubic foot and weigh about 20 pounds. A full complement of DATU's require only a single pair of wires as contrasted with the 4-6 wires per measurand of other methods.

COMPONENTS OF THE SYSTEM

DATU's (Data Acquisition Time-duration Units) — Connected one to each transducer, the DATU's consist of two sub-units: a pulse recognition section which produces an output pulse only when two pulses of the proper time duration are received, and a measuring and output section which, upon reception of a pulse from the first section, produces a high-level output pulse which has a time duration that is linearly proportional to the output of the transducer and hence, proportional to the measurand. The accuracy of measurement is a function of many factors, the most important of which is the transducer characteristics, but accuracies the order of 0.5 to 1% of full scale are to be expected.

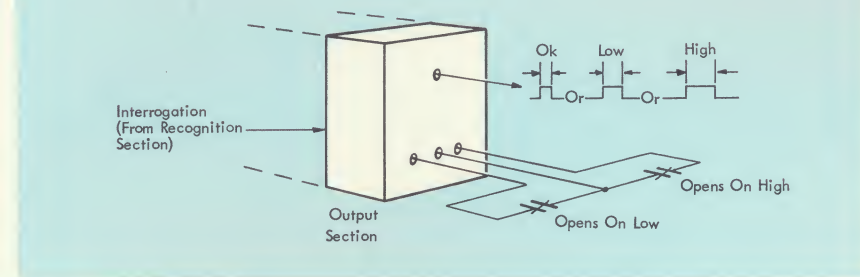
SKETCH OF BASIC DATU



The leads from the transducer to the DATU are kept as short as possible. In fact, the small size of a DATU will often allow it to be mounted inside the transducer case. The only "sensitive" circuits are those between the transducers and the DATU's; the balance are low impedance pulse circuits, so that the systems are not bothered by electrical noise, common-mode signals, or circulating grounds.

The Recognition section is "standard" for all DATU's. The Measuring section varies in construction, depending upon the particular transducer concerned. Some of the variables are: the input level and impedance; single ended or balanced input; the supply of switched or constant excitation power to the transducer.

SKETCH OF LEVEL MONITORING DATU

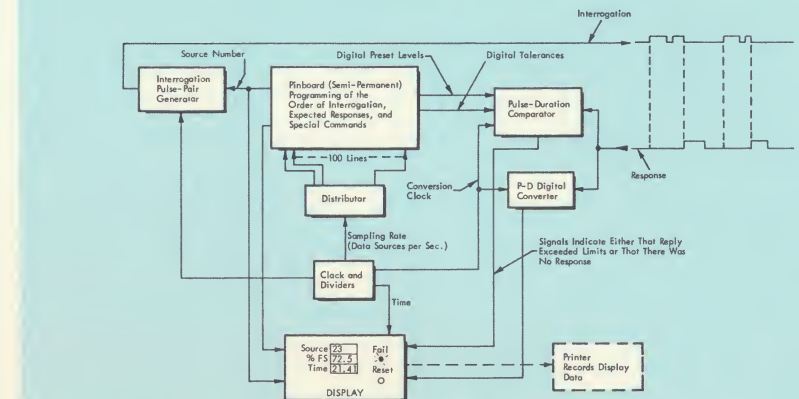


Some monitoring systems do not require full proportional response but, rather, can convey ample information if the reply consists of only on-value, high or low. These systems can use simplified, and less expensive, output sections.

CENTRAL CONTROL

The central control generates the interrogation pulse-pairs and monitors the replies. An operator is given an immediate indication of the reference number of any data source that fails to respond, or responds with a value that is beyond the programmed limits. A tolerance value accompanies each limit. The time of occurrence of a false response is also indicated. A functional diagram of a typical control is given.

FUNCTIONAL DIAGRAM



The pinboard is used in this illustration for programming since it provides a very simple "memory" that needs to be changed only when the interrogation order or the present levels have to be altered.

The control of the entire operation by the clock and dividers allows the sampling rates to be adjusted to the capabilities of the communications channel without major hardware change or adjustment.

A printer can be used with the control, recording the same data that is displayed. This again would be "operation-by-exception" so large amounts of useless data would not be produced. The display exhibits the first false response after manual reset. The printer is not so limited but records all false replies as they occur.

The central control illustrated is a "medium complexity" unit. In some instances, such as a single level monitoring system, only the interrogation pulse generator and a simple display would be required. Conversely, the control can have additional functions such as comparison against previous responses, comparison based upon rate-of-change, and conditional interrogation whereby the frequency of the interrogation of a particular data source is a function of either the absolute value or the rate-of-change.

LINE COUPLERS

The line couplers are used to form bi-directional links between the communications channels and the central control. Their composition and complexity depends on the channel characteristics and the data rates. The simpler couplers, such as the DC line drivers and the coax line drivers only require a single unit. More sophisticated modulation methods, such as frequency-shift keying, carrier modulation or RF links, require transceivers at both ends of the channel. Any possible "grouping" of DATU's, of course, reduces the number of transceivers that are required.

SYSTEMS

The DAS concept provides major advantages in such diversified applications as the instrumentation of supersonic aircraft, atomic submarines, electric power stations and petrochemical pipe lines.

In aircraft the attractive features are the small size and weight of both the electrical equipment and the interconnecting conductors, the low power consumption and the electronically simple, operationally sophisticated data management. In a large aircraft several hundred pounds of wire can be eliminated. The techniques allow data management such that the operation can be the highly desirable "display-by-exception." Coupled to in-flight recorders, the DAS permits large numbers of flight parameters to be continuously monitored (and recorded only if deviant) without accumulating excessively large amounts of data, but never missing an important event.

In the instrumentation of an atomic submarine (or any other large vessel) the ability to monitor several hundred to several thousand transducers without confusion and under severe electrical noise conditions is of prime importance. The "display-by-exception" feature allows continuous monitoring with those in command immediately notified of the location and magnitude of any deviation from the expected conditions.

In an electric power station the distances are considerable — sometimes hundreds of feet — the number of data points is large — several hundred for the maximum efficiency and safety — the noise level is high and the personnel are limited. The DAS is by far the best system under these conditions. The low incremental cost of each additional data point allows the monitoring of many important parameters that would ordinarily have to be ignored for purely economic reasons.

The instrumentation of petrochemical pipelines involves a relatively few data sources separated by many miles. Contemporary techniques are expensive and can only service a limited number of data sources. DAS, by contrast, allows the inexpensive measurement of large numbers of parameters and is essentially independent of the distances. As always, the data management techniques prevent the accumulation of vast amounts of data which merely assert that operation was as expected but do call attention to any deviant value. The walls full of expensive recorders are replaced by an automatic typewriter and a digital indicator.

A quite different application of the DAS technique is in the field of Automatic Operational Testing. The AOT concept is that with the acquisition of sufficient operational data on the performance of a piece of equipment, electrical and/or mechanical, the necessity for periodic maintenance is avoided. If the multiplexer — analog to digital converter approach were attempted, the mass of wires hung in the equipment would, in all probability, render it inoperative. Conversely, the DAS methods, using very high impedance DATU's, allow direct connection at each data source (leads are only a few inches at the most). The single, low impedance, interrogation and response circuits can be routed to produce no interferences.

As previously noted in the examples of other systems, the effective data management reduces the data mass without requiring extensive computational facilities.

FOR FURTHER INFORMATION

The widely diversified applications of these techniques preclude detailed discussions herein. Electronic Specialty Co. engineers will be pleased to propose specific solutions to data acquisition problems. Please write, or phone: Area Code 213, 246-6767.

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